thirdly, because useless publications increase the burden of librarians and scholars. We are far from wishing to discourage genuine attempts to reproduce Fermat's line of thought. In view of the state of mathematical knowledge 250 years ago, Fermat's proof, assuming it to be correct—a point on which expert opinions differ—is as likely to be discovered by a clever schoolboy of seventeen as by a more highly trained mathematician.

Mr. Cashmore, in the tract before us, presents three distinct "proofs," all erroneous. In I. (p. 14) he states that when

$$ax^2+by^2=w^n, \text{ then } w=au^2+bv^2,$$

the letters denoting ordinary integers. A numerical example is enough to show that this is erroneous; thus

$$2^2+5\cdot1^2=3^2, \quad 11\cdot2^2+9^2=5^3;$$

but there are no integral solutions of

$$x^2+5y^2=3, \quad 11x^2+y^2=5.$$

The first of several fallacies in II. occurs on p. 26, and in III. (p. 43) Mr. Cashmore states that when $(p^n-q^n)y^{n-1}$ is divisible by pq, then y is divisible by pq, it being assumed that p and q are integers with no common factor It is seen that this deduction is erroneous by taking

$$p=9, \ q=4, \ y=6, \ n=3.$$

W. E. H. B.

Secrets of Animal Life. By Prof. J. Arthur Thomson. Pp. viii+324. (London: Andrew Melrose, Ltd., 1919.) Price 7*s.* 6*d.* net.

THIS is a collection of forty essays, contributed during recent years by Prof. Thomson to the *New Statesman*, and now collected in a handy and attractive volume. In his own clear and charming style the author seeks "to interest thoughtful readers in the multitudinous problems of animal life," and he wisely enforces the lesson that, in many cases, the solutions of these problems are "secrets" still. Such familiar subjects as the habits of rooks and cuckoos or the "Fall of the Year" are mixed with review-summaries of noteworthy recent zoological literature of general interest such as Watson and Lashley's observations on the "homing" of terns, Emery's researches on the habits of Amazon ants, or Petersen's surveys of the Zostera-beds off the coasts of Denmark. The problems of inheritance and evolution are prominent, as might be expected, and from such papers as "With Darwin Forwards" and "The Mendelian Clue," the "thoughtful reader" may gain a clear introductory view of the fields of biological inquiry, as well as guidance in the way of deeper study. Prof. Thomson never misleads those for whom he writes by implying that after reading him they have no more to learn; his treatment of "The Problem of Cave Blindness," for example, affords a needed corrective to widespread dogmatism on a subject that has appealed to popular imagination since the early days of evolutionary biology.

G. H. C.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

International Relations in Science.

I DO not agree with the proposals made by Prof. D'Arcy Thompson in NATURE of October 23. I think that the less our academies and societies move in this matter the better. For my own part I objected altogether to the proposal made during the war to strike off our records the names of distinguished men of enemy nationality who had been elected "foreign members" before the war. They had not been admitted to any power or rights in consequence of that election, and it was, in my judgment, futile and petty to endeavour to obliterate the record of the honour which had been justly accorded to them.

As to making overtures to, and the reception of overtures from, the academies of those hostile nationalities with which peace is not yet ratified, it seems to me that our own societies and academies should at present neither offer nor accept any such overtures. They are mere formalities and demonstrations without any real significance or value, and must be, and are often designed to be, misleading. On the other hand, I think every individual should act according to his own feeling and judgment, and not according to mass sentiment, in regard to entering into friendly relations with German men of science. At present I personally could not accept such relations. I wish to reserve all action in the matter until my memory of many things has faded. But I will never wittingly treat even those whom I most dislike with less than justice tempered by generosity.

E. RAY LANKESTER.

The Response of Plants to Wireless Stimulation.

A GROWING plant bends towards light; this is true, not only of the main stem, but also of its branches and attached leaves and leaflets. This movement in response is described as the tropic effect of light. Growth itself is modified by the action of light: two different effects depending on the intensity are produced; strong stimulus of light causes a diminution of rate of growth, but very feeble stimulus induces an acceleration of growth. The tropic effect is very strong in the ultra-violet region of the spectrum with its extremely short wave-length of light; but the effect declines practically to zero as we move towards the less refrangible rays, the yellow and the red, with their comparatively long wave-length. As we proceed further in the infra-red region we come across the vast range of electric radiation, the wave-lengths of which vary from the shortest wave I have been able to produce (0·6 cm.) to others which may be miles in length. There thus arises the very interesting question whether plants perceive and respond to the long æther-waves, including those employed in signalling through space.

At first sight this would appear to be very unlikely, for the most effective rays are in the ultra-violet region with wave-length as short as 20×10^{-6} cm.; but with electric waves used in wireless signalling we have to deal with waves 50,000,000 times as long. The perceptive power of our retina is confined within the very narrow range of a single octave, the wave-lengths of which lie between 70×10^{-6} cm. and 35×10^{-6} cm. It is difficult to imagine that plants could perceive radiations so widely separated from each other as the visible light and the invisible electric waves.

But the subject assumes a different aspect when we take into consideration the total effect of radiation on the plant. Light induces two different effects which may broadly be distinguished as external and internal. The former is visible as movement; the latter finds no outward manifestation, but consists of an "up" or assimilatory chemical change with concomitant increase of potential energy. Of the two reactions, then, one is dynamic, attended by dissimilatory "down" change; the other is potential, associated with the opposite "up" change. In reality, the two effects take place simultaneously; but one of them becomes predominant under definite conditions.

The modifying condition is the *quality* of light. With reference to this I quote the following from Pfeffer:—"So far as is at present known, the action of different rays of the spectrum gives similar curves in regard to heliotropic and phototactic movements, to protoplasmic streaming and movements of the chloroplastids, as well as the photonastic movements produced by growth or by changes of turgor. On the other hand, it is the less refrangible rays which are most active in photosynthesis."[1] The dynamic and potential manifestations are thus seen to be complementary to each other, the rays which induce photosynthesis being relatively ineffective for tropic reaction, and *vice versa*.

Returning to the action of electric waves, since they exert no photosynthetic action they might conceivably induce the complementary tropic effect. These considerations led me to the investigation of the subject fourteen years ago, and my results showed that very short electric waves induce a retardation of rate of growth; they also produce responsive movements of the leaf of Mimosa when the plant is in a highly sensitive condition.[2] The energy of the short electric waves is very feeble, and undergoes great diminution at a distance; hence the necessity for employment of a specimen of plant in a highly sensitive condition.

I resumed my investigations on the subject at the beginning of this year. I wished to find out whether plants in general perceived and responded to long æther-waves reaching them from a distance. The perception of the wireless stimulation was to be tested, not merely by the responsive movement of sensitive plants, but also by diverse modes of response given by all kinds of plants.

The Wireless System.

For sending wireless signals I had to improvise the following arrangement, more powerful means not being available. The secondary terminals of a moderate-sized Ruhmkorff's coil were connected with two cylinders of brass, each 20 cm. in length; the sparking took place between two small spheres of steel attached to the cylinders. One of the two cylinders was earthed and the other connected with the aerial 10 metres in height. The receiving aerial was also 10 metres in height, and its lower terminal led to the laboratory, and connected by means of a thin wire with the experimental plant growing in a pot; this latter was put in electric connection with the earth (Fig. 1). The distance between the transmitting and receiving aerial was about 200 metres, the maximum length permitted by the grounds of the institute.

I may state here that with the arrangement described above I obtained very definite mechanical and electric response to wireless impulse. For the former I employed the plant Mimosa; the latter effect was detected in all plants, sensitive and ordinary. Limitation of space will allow only a detailed description of the responsive modification of growth.[3]

Effect of Wireless Stimulation on Growth.

For the detection of variation of growth it was necessary to devise the extremely sensitive balanced crescograph. In this apparatus a compensating movement is given to the plant-holder by which the plant subsides exactly at the same rate as its growth-elongation, so that the tip of the plant remains at the same point. This perfect balance is attained by a variable regulator. The compound magnifying lever attached to the plant records the movement of growth. Under exact balance the record is horizontal. Any induced acceleration of growth would upset the balance, with a resulting down record; induced retardation, on the other hand, would cause an upset in the opposite direction and an up curve. The results given below show that growing plants not only perceive, but also respond to the stimulus of electric waves. These effects were found in all growing plants. The following records were obtained with the seedlings of wheat.

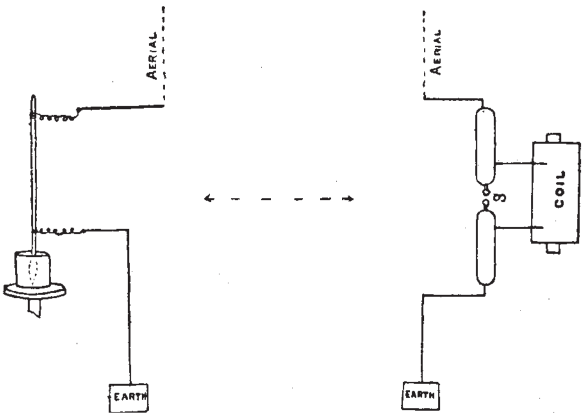

Fig. 1.—Diagrammatic representation of the method of wireless stimulation. On the right is seen the generating apparatus. The tip of the growing plant is connected with the receiving aerial, and the lower part or the flower-pot is earthed.

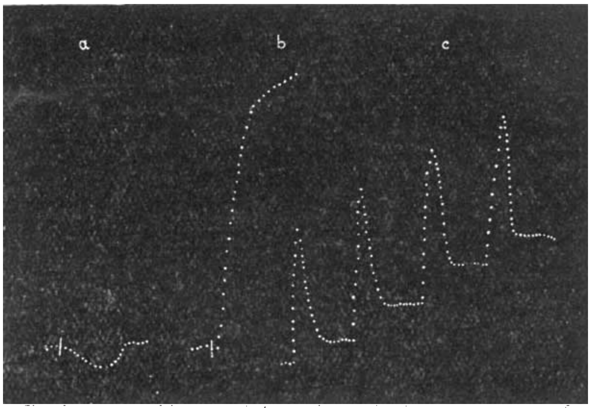

Fig. 2.—Automatic records obtained with the balanced crescograph showing the effects of wireless stimulation on growth. (*a*) Feeble stimulus inducing acceleration; (*b*) strong stimulus inducing retardation of rate of growth; (*c*) series of growth responses by variation of growth due to uniform moderate stimulation. Up-curve represents retardation of growth and down-curve acceleration (seedling of wheat).

Effect of Feeble Stimulus.—Experiment 1: I first studied the effect of feeble stimulus. This was secured by decreasing the energy of sparks of the radiator. The response was an acceleration of rate of growth as seen in Fig. 2, (*a*). This is analogous to the accelerating effect of light stimulation of subminimal intensity.

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[1] Pfeffer, "Physiology of Plants," vol. ii., p. 104.

[2] Bose, "Plant Response," p. 618. (1905.)

[3] A detailed account of the response of plants to wireless stimulation will be found in the Transactions of the Bose Institute, vol. ii., to be published in November, 1919.

Effect of Strong Stimulus.—Experiment 2: The maximum energy radiated by my transmitter, as stated before, was only moderate. In spite of this, its effect on plants was exhibited in a very striking manner. The balance was immediately upset, indicating a retardation of the rate of growth. The latent period, *i.e.* the interval between the incident wave and the response, was only a few seconds (Fig. 2, (*b*)). The record given in the figure was obtained with the moderate magnification of 2000 times only; but with my crescograph the magnification can easily be raised ten million times, and the perception of plant to the space-signalling can be exalted in the same proportion.

Under an intensity of stimulus slightly above the subminimal, the response exhibits retardation of growth followed by quick recovery, as seen in the series of records given in Fig. 2, (*c*). The perceptive range of the plant is inconceivably greater than ours; it not only perceives, but also responds to the different rays of the vast æthereal spectrum. J. C. BOSE.

Calcutta, August 16.

A New British Enchytræid Worm.

IN a collection of worms brought from Lapworth by Mr. Hillman on August 11, I found one which is new to this country, and of great interest on account of its unusual character and relationships. In 1877 Vejdovsky described his *Pachydrilus sphagnetorum.* Eleven years later Michaelsen added to it a variety named *glandulosus.* In course of time the name Pachydrilus was changed to Marionina, and the two worms above-named were placed as distinct species under this genus, forming a section by themselves on account of their aberrance. They both had the girdle thrown forward, the spermathecæ were free in the cœlom, the septal glands were more numerous than in the type, and there were other peculiarities. In Michaelsen's "Oligochæta," published in 1900, they appear as *Marionina sphagnetorum*, Vejd., and *M. glandulosa,* Mich.

In 1913 I described a new British Enchytræid (*Chamaedrilus chlorophilus,* Friend), which could not be fitted into any then known genus. Its relationships were discussed and its affinities with the two aberrant Marioninas pointed out. On finding *M. glandulosa,* I was for a time in doubt about its true name, as it so closely resembled Chamædrilus. Careful study, however, shows that the three worms are very nearly related, and must be referred to one and the same genus. In Marionina the blood is slightly coloured, in Chamædrilus it is quite colourless. In the former the spermathecæ are free, whereas in Chamædrilus they are attached to the intestine. In all other respects they agree. The forward position of the girdle, the shape and number of the setæ, absence of salivary glands, form of spermathecæ, size of cœlomic corpuscles and chloragogen cells, enlarged number of septal glands, incised brain, and other important characters, all point to one genus.

They are exceedingly slender worms, and Vejdovsky has pointed out a peculiarity in *M. sphagnetorum* which is of special interest. Like certain waterworms, it can multiply by subdivision. We have here, very clearly, a genus which links the Enchytræids with some of the other families of worms. Details cannot be discussed now, but it is evident that we shall for the present have to regard the genus Chamædrilus as consisting in this country of three species, viz. *Chamaedrilus sphagnetorum,* Vejd., *C. glandulosus,* Mich., and *C. chlorophilus,* Friend. The generic characters are roughly as follows:—

CHAMÆDRILUS.—Girdle advanced to segment 10, 9, or 8; nephridia begin in 8/9 or 9/10; spermathecæ with posterior outgrowth, either free or attached to the intestine; cœlomic corpuscles and chloragogen cells large; blood colourless or but slightly tinged with yellow or red; the dorsal vessel originating behind the girdle and possessing no anterior commissures (apparently). Salivary gland absent, brain deeply incised. Related to Stercutus and Bryodrilus.

HILDERIC FRIEND.

"Cathay," Solihull, September 24.

A Photoelectric Theory of Colour Vision.

IN view of the recent letters from Prof. Joly and Sir Oliver Lodge under the above heading, I may be allowed to point out that such a theory of colour vision was advanced by me in a lecture delivered before the Röntgen Society on January 7 last, and published in the Journal of the society for April. After referring to Prof. Joly's views as to the nature of the change taking place in the formation of the latent image and in radio-therapy, I said: "In my opinion, it is unnecessary to assume that a photochemical change is the cause of the visual sensation. It appears to me sufficient to suppose that photoelectric action takes place in the rods or cones, so that we have a separation of electrons resulting in electrification of the nerve-cells which set up the nervous impulse to the sensorium." A number of familiar facts were adduced in support of this view, and it was mentioned that the peaked curve which shows the relation between the sensitiveness of the eye for light of different wavelengths bears a very close resemblance to the curve which shows the variation of photoelectric activity with wave-length. H. STANLEY ALLEN.

Luminous Worms.

AROUND Nottingham forty-five years ago it was a common practice among anglers to search the meadows by aid of a lantern for "dew-worms and cockspurs," as they were locally known. After collection they were placed in damp moss in a dark shed for a few days until they were "scoured"; this brought them into condition, and rendered them more attractive as bait and fresher and redder in colour. After this treatment worms were phosphorescent for about one-fourth of the entire length of the body, while the light was most noticeable in the ventral region. H. E. ALDRIDGE.

40 Great Queen Street, Dartford.

RECONSTRUCTION.

IT has been a reproach, not without foundation, frequently cast at the British Empire that there has been hitherto a lack of reasonable and sufficient organisation. The circumstances arising out of a state of war have led necessarily to the institution of a number of new Departments which have been called into existence hastily and without adequate consideration. Some of these will, of course, disappear, and others will remain to be reconstituted. In view of these facts the Government did wisely in July, 1917, in appointing a Committee with the purpose of considering the changes which would become necessary after the war, and the report of one of its Sub-Committees, that on the Machinery of Government,